LARGEST AUSTRALITE FROM VICTORIA, AUSTRALIA

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Abstract

The largest australite so far discovered in Victoria is a boat-shaped specimen weighing 173·621 gm and with a specific gravity of 2·417. It was found about the year 1900, and has only recently been brought to scientific notice. Found in the Connangorack Swamp area, Western Victoria, it was regarded for many years as 'some blackfellow's stone'.

Introduction

The largest australite collected to date in Victoria was recently (10 August 1970) added to the rock and mineral collection of the National Museum of Victoria (E4753). It is the heaviest of six australites found in Victoria that weigh over 100 gm. The specimen is a somewhat asymmetrical boat-shaped form (Pl. 12, figs. A-D) weighing a little over 173·5 gm, sixth heaviest of 23 australites weighing over 100 gm from the extensive Australian strewn-field of over 5×10^6 km^2 (Baker, 1969, Table 1).

Donated by Mr Alexander S. McDonald of 'Strathalbyn'. Cavendish, this australite came from the E. bank of Connangorack Swamp (or Ten Mile Swamp) 11 km E. of Toolondo on the Natimuk-Hamilton Railway Line, and 40 km SW. of Horsham (Fig. 1).

The specimen was found by the late Mr G. A. McDonald about the year 1900 while ploughing on a sand hill. It was regarded by him as 'some blackfellow's stone' until he saw the australites on display in the National Museum of Victoria in Melbourne.

Known Large Boat-Shaped Forms

Only four large boat-shaped australites of over 100 gm have so far been located. Two of these are from Victoria, one from S. Australia, and one from W. Australia. Their weights, dimensions, and specific gravity values are listed in Table 1.

The specimen from Karoonda has been considerably abraded (Baker 1969, p. 61), while the Narembeen australite has been significantly etched so as to form numerous deep, solution grooves (Baker 1961a, Pl. 1). The specimen from Port Campbell (190 km SSE. of Connangorack Swamp) is the best preserved, with much less etching and no signs of abrasion (Baker 1969, Pl. 5, 9). The Connangorack Swamp specimen is also relatively well-preserved (Pl. 12) with few signs of abrasion and no significant loss from terrestrial etchants since its flaked equatorial zone was produced after landing on the earth's surface.

Table 1

Boat-shaped australites over 100 gm

Locality	Weight (gm)	Measurements* (mm)	Specific Gravity	Reference
1. Karoonda, S.A.	208·9	82 × 46·8 × 37·9	(not given)	Fenner 1955
2. Connangorack Swamp, Vic.	173·621	78·9 × 47·6 × 34	2·417†	(this paper)
3. Port Campbell, Vic.	141·575	86·2 × 41·3 × 30·5	2·414	Baker 1969
4. Narembeen, W.A.	107·46	64 × 37 × 30·5	2·431	Baker 1961a

† Temperature of distilled water = 19°C
* Measurements are length width depth

The 23 largest known australites range from 101 gm to 265 gm (Baker 1969), and vary in shape from round cores through oval cores to boat-shaped and dumbbell-shaped forms. As noted for australites generally, the specific gravity values for the large boat-shaped forms increase from the most easterly (Port Campbell) through the Connangorack specimen to the most westerly occurrence (Narembeen).

As the sixth heaviest australite the Connangorack Swamp specimen is approximately 92·5 gm lighter than the heaviest, which is an oval core from Warralakin, W. Australia (Baker 1962). It is 69·5 gm lighter than a round core from Newdegate, W. Australia (McCall 1965), 45·5 gm less than a round core from Lake Yealering, W. Australia (Fenner 1955), 35 gm less than an abraded boat-shaped form from Karoonda, S. Australia (Fenner 1955), and only 2·5 gm less than the largest known dumbbell from Cuballing, W. Australia (Baker 1966). It is thus the second heaviest boat-shaped australite known (Table 1).

Other Australites from Horsham Region

A considerable number of smaller australites, mostly 1-40 gm, have been recorded from the region shown in the map (Fig. 1) of *c* 10,000 km^2 during the past 75 years at the following localities: Grampian Mountains (Dunn 1912, Tilley 1922), around Balmoral (Dunn 1912, Baker 1964), Horsham (Walcott 1898, Dunn 1908, 1912, Baker 1959b, 1961b), Hamilton (Dunn 1912, Baker 1959b), Harrow (Baker 1940, 1955), Glenthompson and Murtoa (Baker 1957), Dunkeld (Baker 1957, 1959b), Polkemmet East (Baker 1959b), Kanagulk, Telangatuk East, and Mt Talbot near Toolondo (Baker 1959a), Nurrabiel (Baker 1964), Lower Norton (Baker 1964, 1969), and Noradjuha (Baker 1964).

The specific gravity values for 140 or so australites from this region have been determined thus: Balmoral (14 determinations), Hamilton (10), Harrow (2), Mt William (2), Polkemmet East (1), Stony Creek Basin, Grampians (2), and Telangatuk East (9). See Baker and Forster (1943). Later 34 specific gravity determinations were made for australites from Harrow (Baker 1955), followed

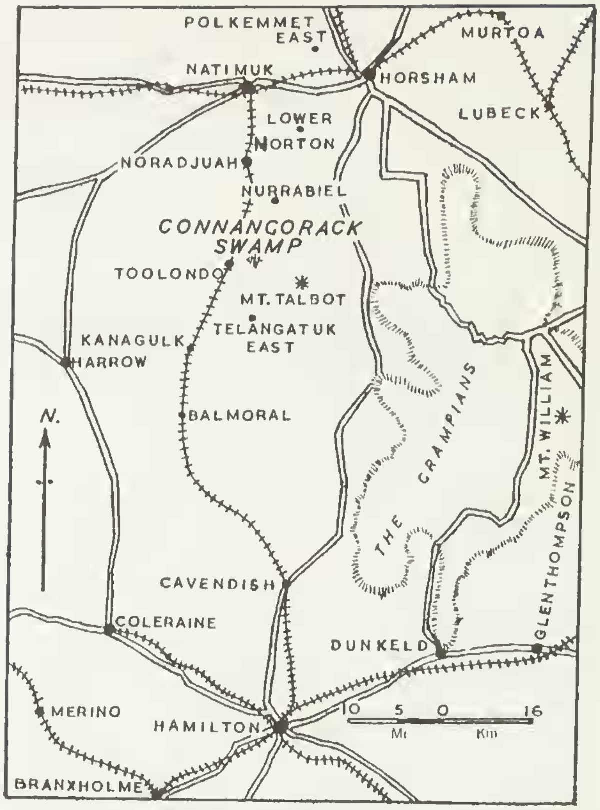

Fig. 1—Sketch map of part of W. Victoria showing discovery site of australite at Connangorack Swamp and other australite localities in the Horsham region.

by 29 from Kanagulk and five from Mt Talbot (Baker 1959a), one from Lower Norton (Baker 1964), and 33 from Nurrabiel (Baker 1964). The average is 2·408, a little lower than for the Connangorack Swamp australite (2·417). The overall range from this region is 2·335-2·468, disregarding specimens known to contain sizable internal cavities (Baker 1961b). The total weight of australite glass involved in the determinations is approximately 1,238 gm, and the Connangorack Swamp specimen contributes a little over one sixth of this weight. The ranges in specific gravity for the localities in this region are set out in Table 2.

The two entries for Hamilton, Balmoral, and Harrow arise from discoveries at different times having been studied by different authors, resulting in somewhat divergent average specific gravities and, in some, omission of the details of weights in the papers describing the specimens. There is mainly a random distribution

Table 2

Specific gravity values for australites in the Horsham region

Locality	No. of spec.	Total Wt. (gm)	Range in S.G.	Average S.G.
Stony Cr. Basin, Grampians	2	0·782	2·335–2·376	2·356
Hamilton	4	8·824	2·339–2·459	2·378
Balmoral	8	14·516	2·356–2·428	2·389
Harrow	2	135·056	2·391	2·391
Hamilton	6	?	2·395–2·406	2·400
Kanagulk	34	314·577	2·380–2·441	2·404
Telangatuk E.	9	60·232	2·378–2·437	2·408
Mt. Talbot	5	14·840	2·392–2·424	2·410
Nurrabiel	34	63·048	2·374–2·462	2·410
Balmoral	6	?	2·389–2·455	2·411
Connangorack Swamp	1	173·621	2·417	2·417
Mt. William, Grampians	2	?	2·393–2·462	2·418
Harrow	34	305·050	2·386–2·468	2·420
Lower Norton	1	115·920	2·429	2·429
Polkemmet E.	1	31·885	2·433	2·433
TOTALS	149	1,238·351	2·335–2·468	2·408

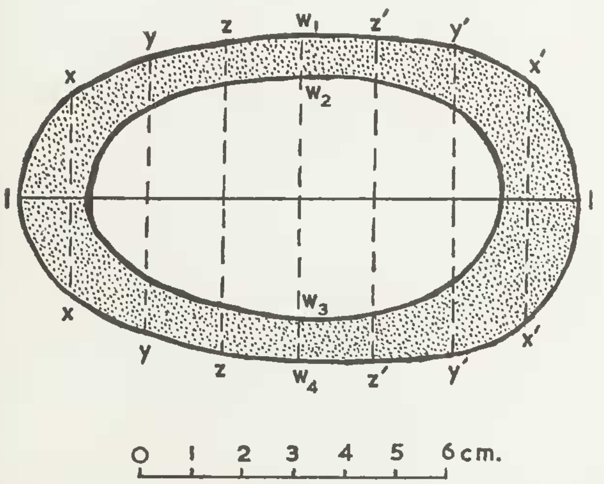

Fig. 2—Plan showing restored primary form of the Connangorack Swamp australite.
w_2w_3 = 47·6 mm = width of secondary form as found
w_1w_4 = 64 mm = width of primary form by reconstruction
ll = 110 mm = length of reconstructed primary form
xx and x′x′ = 39 mm and 48 mm respectively
yy and y′y′ = 54 mm and 61 mm respectively
zz and z′z′ = 61 mm and 64 mm respectively
Dotted area represents tektite glass lost from the primary form on production of the secondary boat-shaped form.

through this region of specific gravity values whose average tends to increase from N. to S., but this is scarcely significant when superposed upon the general specific gravity increase from SE. to NW. across 4,000 km of the australite strewnfield (Baker 1959b).

Description of Form

The large boat-shaped australite from Connangorack Swamp is slightly asymmetrical in plan and elevation. It has a well-developed flaked equatorial zone (Pl. 12, figs. B, D) carrying a few etch pits up to 1 mm diameter, occasional flow lines (schlieren) accentuated by natural etching, and occasional shallow etch grooves trending parallel with the depth of the flaked zone. These grooves range up to 10 mm long and 1 mm wide; in cross section they are generally U-shaped and up to *c.* 0·25 mm deep.

A sharply marked rim separates the equatorial zone from the convexly curved posterior surface, and this delineates the limits of post-landing exfoliation (spalling) of tektite glass constituting the aerothermal strained zone (cf. Baker 1963) that arose as a secondary feature during hypersonic transit through the earth's atmosphere. As a consequence, the transition from anterior surface to equatorial zone is relatively smoothly rounded, and not demarked by a sharp rim as for the posterior surface. The resultant configuration below the rim region (Pl. 12, figs. B, D) fundamentally represents the basal surface of the aerothermal strained zone, and hence indicates the depth of penetration of aerodynamic heating from the anterior surface inwards.

A few solution etch grooves also occur on the posterior and anterior surfaces, mostly short (Pl. 12, fig. C), but a longer one on the posterior surface (Pl. 12, fig. A) is arcuate in outline and up to 0·5 mm deep.

The posterior surface of the specimen (Pl. 12, fig. A) tends to be smoother than the anterior surface (Pl. 12, fig. C) due to less frequent etch pits and etch grooves. Flow swirls are just detectable and not pronounced as on some australites (e.g. Baker 1969, Pl. 5A). The vague flow swirl on the posterior surface of the Connangorack Swamp australite measures approximately 30 mm by 20 mm, and is made faintly evident by soil etchants. Arcuate to subcircular pits about 2·5 mm across are evidently chatter or percussion marks subsequently modified by solution etching.

Dimensions of Specimen

The length is 78·9 mm but the width ranges from 47·6 in the central regions to 39 mm towards the broader and 28·5 mm towards the narrower end. The depth ranges from 34 mm in the central regions to 32·5 mm towards the deeper end and 28·5 mm towards the shallower. One side is approximately parallel with the long axis, as seen from the top edge of Pl. 12, fig. A and the bottom edge of Pl. 12, fig. C, whereas the opposite side is significantly curved, as revealed by the bottom edge of Pl. 12, fig. A and the top edge of Pl. 12, fig. C. Although shorter than the large boat-shaped australite from Port Campbell (Baker 1969), the Connangorack Swamp specimen is significantly broader and deeper (cf. Table 1), thus accounting for the form being a little over 32 gm heavier. No attempt was made to determine a radius of curvature for either surface along the elongated axis. Across the short diameter the arcs of curvature are R_F 27 mm and R_B 32 mm.

The arc and radius of curvature R_B of the posterior surface provides some concept of the nature of the primary form, while that of the anterior surface gives an approximate concept of the way the primary form has been secondarily modified. With the boat-shaped form trimmed in a stable position during earthward flight, which was one of aerodynamic equilibrium with the long axis of the specimen normal to the flight direction earthwards and the shorter of the two lateral axes (for a triaxial ellipsoid) parallel with the flight path, the amount of ablation from the forward surface of the specimen was quite significant. This and exfoliation of the forward surface resulted in a loss of *c.* 23 mm depth of the australite.

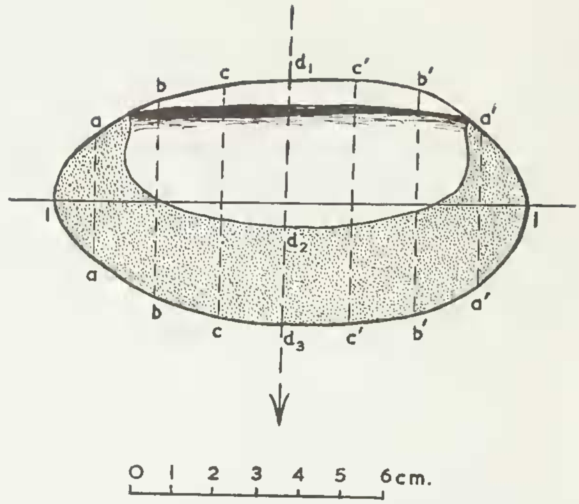

Fig. 3—Side elevation to show restoration of the primary form from the residual boat core (boat-shape obtained from trace of side elevation in Pl. 12, fig. B). Posterior surface uppermost.
d_1d_2 = 34 mm = depth of secondary form as found
d_1d_3 = 56·5 mm = depth of reconstructed primary form
d_2d_3 = 22·5 mm = depth of ablation along the polar axis combined with glass lost by subsequent terrestrial spallation
ll = 110 mm = length of reconstructed primary form
aa and a'a' = 27 mm and 37 mm respectively
bb and b'b' = 45 mm and 52 mm respectively
cc and c'c' = 53·5 mm and 56 mm respectively
Arrow points down the flight path earthwards. The specimen trimmed in flight with its long axis normal to the flight direction. Dotted areas represent australite tektite glass lost from the primary form on production of the secondary form.

Reconstruction results in the outline forms depicted in Figs. 2 and 3. From these it is estimated that the dimensions of the primary ellipsoid were approximately 110 mm by 64 mm (width) by 56·5 mm (depth). Loss during earthward flight and from terrestrial agencies resulted in a reduction of *c.* 32 mm in length, *c.* 16 mm in width, and *c.* 22·5 mm in depth.

Description of Plate 12

Boat-shaped australite from Connangorack Swamp (natural size)

Fig. A—Posterior surface with ill-defined flow swirls, distinct etch pits, and chatter (or percussion) marks.

Fig. B—Side elevation showing flaked equatorial zone with natural solution etch grooves (posterior surface uppermost).

Fig. C—Anterior surface with short natural solution etch grooves, a few etch pits, and several chatter (or percussion) marks.

Fig. D—End elevation showing flaked equatorial zone and nature of arcs of curvature of the two surfaces (posterior surface uppermost).

Acknowledgements

The author is grateful to Dr A. W. Beasley for drawing attention to this recent addition.

Addendum

An oval australite core recently described by W. H. Cleverly from Lake Ballard, Western Australia (*Jl R. Soc. West. Aust.* 54: 14-16, 1971) measures 60 × 57 × 44 mm and weighs 202·29 gm. It is the fourth australite from Western Australia weighing over 200 gm and the fifth heaviest australite known to science, as a heavier one weighing over 200 gm is recorded from Karoonda, South Australia.

Consequently, the Connangorack Swamp
ralite brought to scientific notice.
specimen becomes the seventh heaviest aust-

References

Baker, G., 1940. Some australite structures and their origin. *Min. Mag.* 25: 487-494.

————, 1955. Australites from Harrow, Victoria. *Min. Mag.* 30: 596-603.

————, 1957. The role of australites in aboriginal customs. *Mem. natn. Mus. Vict.* 22(8): 1-26.

————, 1959a. Australites from Kanagulk, Telangatuk East and Toolondo, Western Victoria. *Mem. natn. Mus. Vict.* 24: 69-89.

————, 1959b. Tektites. *Mem. natn. Mus. Vict.* 23: 5-313.

————, 1961a. A naturally etched australite from Narembeen, Western Australia. *Jl R. Soc. West-Aust.* 44(3): 65-68.

————, 1961b. A perfectly developed hollow australite. *Am. J. Sci.* 259: 791-800.

————, 1962. The largest known australite and three smaller specimens from Warralakin, Western Australia. *Jl R. Soc. West. Aust.* 45(1): 12-17.

————, 1963. Exfoliation from the anterior surface of a flanged australite button, Port Campbell, Victoria, Australia. *Chemie Erde* 23(2): 152-165.

————, 1964. Australites from Nurrabiel, Western Victoria. *Mem. natn. Mus. Vict.* 26: 47-75.

————, 1966. The largest known dumbbell-shaped australite. *Jl R. Soc. West. Aust.* 49(2): 59-63.

————, 1969. Five large australites from Victoria, Australia, and their relationships to other large forms. *Mem. natn. Mus. Vict.* 29: 53-64.

Baker, G., and Forster, H. C., 1943. The specific gravity relationships of australites. *Am. J. Sci.* 241: 377-406.

Dunn, E. J., 1908. Obsidian buttons. *Rec. Geol. Surv. Vict.* 2(4): 202-207.

————, 1912. Australites. *Bull. Geol. Surv. Vict.* 27: 3-23.

Fenner, C., 1955. Australites Pt. VI. Some unusually large australites. *Trans. R. Soc. S. Aust.* 78: 88-91.

McCall, G. J. H., 1965. The heaviest recorded australite. *Aust. J. Sci.* 27: 267.

Tilley, C. E., 1922. Density, refractivity and composition relations of some natural glasses. *Min. Mag.* 19: 275-294.

Walcott, R. H., 1898. The occurrence of so-called obsidian bombs in Australia. *Proc. R. Soc. Vict.* 11: 23-53.